XXIV. *A note on the Cryptic Resemblance of two South American Insects, the moth* ~~Dracen~~ta rusina, *Druce, and the Locustid,* Plagioptera bicordata, *Serv.* By Edward B. Poulton, D.Sc., M.A., F.R.S., Hope Professor of Zoology in the University of Oxford and Fellow of Jesus College, Oxford.

[Read October 17th, 1906.]

Plate XXXII.

By the kindness of my friend Mr. W. J. Kaye I have had the opportunity of making a detailed examination of the deeply interesting moth exhibited by him on Oct. 17, 1906 (Proc. Ent. Soc. Lond. 1906, p. lxxviii). Mr. Kaye has also kindly permitted me to add the results of my study, in the form of the following note, to Plate XXXII of the Transactions,—the Plate illustrating his exhibit of Oct. 17 last.

Before I had heard of Mr. W. B. Grove's suggestion that leaves attacked by fungi are the models resembled by *Kallima* (Proc. Ent. Soc. Lond. 1905, pp. xxxii, xxxiii), I too should have thought that the transparent networks of *Dracenta* represent "the work of some leaf-mining insect." Mr. Grove's suggestion however throws new light on the problem, and I now think that the moth bears a cryptic resemblance to a dead leaf partially destroyed by fungi. Mr. Kaye also considers that this interpretation is probably correct, and he points out that the position in which the moth was found is in favour of it.

With Mr. Kaye's permission I have added to Plate XXXII, figures of the upper and under surface of the Locustid, *Plagioptera bicordata*, for comparison with the moth.

It is interesting to observe that the effect of the ragged outline of the wings of *Dracenta* is intensified in precisely the same manner as in *Grapta* (*Polygonia*) *c. album* (Proc. Ent. Soc. Lond. 1903, pp. xxvi—xxviii). In both insects

the fore- and hind-wings are sufficiently separated to produce a notch far deeper than any other in the irregular contour.

The upper surface of *Dracenta rusina* exhibits an almost uniform pale brown colour with a narrow darker margin. Both wings are marked with reticulations of a tint faintly darker than the ground-colour, and barely visible at a little distance. The ground-colour is also very faintly deepened in tint at the extreme margin of the transparent networks. Although this deepening requires the use of a lens for its due appreciation, its effect upon the unassisted eye is undoubtedly considerable, the patches gaining a sharper outline and a greater prominence. Along the costa of the fore-wing the linear margin is made up of an irregular alternation of dark and light sections. The effect is to break up the hard line of the costa and produce the appearance of an outline eaten at irregular intervals into little shallow bays, each corresponding to one of the light sections.

The chief projecting angles bounding the deeply cut bays along both hind margins curve either upward or downward out of the plane of the wings. Corresponding angles on the two sides are bent in the same direction in Mr. Kaye's specimen, and thus probably retain the appearance presented in life, an appearance promoting the cryptic resemblance to a tattered piece of dead leaf with the most prominent angles of its margin bent or twisted. The curvature is chiefly marked in the principal or costal angle of the small bay at the extreme apex of the fore-wing, and is here in a downward direction. The three chief projections near the anal angle of the same wing are on the other hand bent upward. In the hind-wing the curvature is much less pronounced, the chief projection at the apical angle being bent very gently downward, that at the anal angle rather less gently upward.

Transparency is attained very much as in *Castnia*,* by the scales themselves becoming transparent and, at least in some of the areas, set on edge. The obliquity of the scales varies in different parts of the wing, but in the most completely transparent patches the two causes,—transparency and verticality,—always co-operate, and of the two the latter seems to be the more effective. The evolution of a transparent area from one in which the same effect

* Linn Soc. Journ.—Zool., vol. xxvi, p. 601, Pl. 44, Fig. 6.

was more roughly produced by means of light, strongly reflecting, opaque body-colour is in some respects clearer in this moth than in butterflies of the genus *Kallima*. The presumably older less realistic method is found in the small patches placed nearest the base of the fore-wing, and in the small distinct patches bordering the lenticular nearly closed bay between fore- and hind-wing. The large irregular network of areas grouped round the anal angle of the fore-wing is clear and transparent over the greater part of its extent, but the meshes nearest to the anal angle itself are far less transparent, being covered with pale pigmented scales. On the hind-wing, apart from the border of the lenticular bay, the same contrasted stages of evolution are even better seen. Thus the anal network of areas is pale-coloured over its anal half, transparent over the other half. Of the network at the base of the wing, the three meshes—two large and one small—nearest to the inner margin are pale, the others transparent. A small isolated area coming to the very edge of the inner margin between this network and that last-named, is unusually opaque, but even this lets through a little light. The distinction between the two methods by which transparency is suggested can, in some cases, be made out in the representation given in Fig. 1, Plate XXXII. Thus the small basal pale patch of the fore-wing can be recognized as somewhat different from the transparent areas of the network which lies next to it. Transition is easy; for the pale reflecting areas are also transparent, although to a much less extent than the others. We can apparently recognize four stages in the evolution of the clearest and most transparent areas of *Dracenta*:—(1) Opaque white strongly reflecting pigment, employed as an artist would use "body-colour" to suggest the bright light coming through a hole. (2) The pigment becomes less opaque and semi-transparent; so that some effect is produced when the surface of the wing is in deep shadow with a bright light on the other side of it. (3) The scales lose their pigment and become completely transparent. (4) The scales assume a more upright position so that most of the light passes between them; in the fullest development of this stage they become vertical. The second and fourth of these stages are very evident on part of the wing of this interesting moth and I think the third is also present. Some of the

pale patches are more opaque than others, but the first stage in its typical form is not now to be found: the species has passed beyond it.

The under surface is in many respects very different from the upper. The pale brown ground-colour has the appearance of being overspread with a greyish bloom. The dark line is wanting from the costal and inner margins, but is far broader than on the upper surface along the hind-margin of both wings, especially so on the posterior. Centrally this broad marginal band passes by a gradual transition into the ground-colour.

The transparent areas themselves are, of course, the same on both surfaces, but on the under-side of the hind-wing there is developed around and between them a black reticulated pattern with its meshes in some parts filled in with unaltered ground-colour, in others with a darker pigment, in others again with a much paler reflecting pigment. Furthermore many of the pale-coloured areas of the upper surface are distinctly darker on the under surface; especially those near the anal angle of both wings, as can be well seen by comparing Fig. 1A with Fig. 1. The whole effect on the hind-wing is to produce the impression of a fungoid growth spreading in reticulate fashion over the surface, and producing here and there at points longest exposed to injury, the culminating effect of transparency. The scattered masses of transparent areas appear to become the centres of greatest injury in an almost continuous network of decay. This effect, which probably represents in considerable detail the results of a leaf-attacking fungus, can in large part be made out in the representation of the left hind-wing under-side (right side of the figure) shown in Fig. 1A, Plate XXXII. The transparent meshes of the moth may represent actual holes in a leaf, or its transparent cuticle filling in the meshes of a network whose strands are the resistant fibro-vasular bundles. The latter appears to be the more probable interpretation.

The most characteristic feature on the under surface of the fore-wing is the development of large patches of dark pigment which appear to stand out in low relief. This is especially the case with the largest and most prominent patch placed a little below the centre of the wing and distinctly seen, as indeed are all the others, on Fig. 1A of the accompanying plate. Except in the case of the small irregular dark areas near the apical and the anal angles,

these patches are traversed by a network of black pigment enclosing in its meshes scales of a lighter but still dark tint. This, although not well seen in Fig. 1A, is especially clear and well defined in the chief patch alluded to above.

It is evident that the network covering the dark patches represents at another stage the network with transparent and pale meshes. It is probable that the former corresponds to the fullest activity in the life of a leaf-destroying fungus, the latter to its ultimate effect. It has been already suggested that intermediate stages are represented on the under surface of the hind-wing.

Comparing these two surfaces of the wings we see that the under possesses a pattern of varied and complex detail, representing as I believe prominent stages in the destruction of a dead leaf by a fungus. The upper surface on the contrary exhibits a pattern strong in contrast but deficient in detail; representing only the ultimate effect of such an attack upon the tissues of a dead leaf. The pale meshes are not only paler than on the under surface, but the margins of the networks appear to be cleanly and sharply punched through the substance of the wing. The difference in this respect between the upper and under surface is fairly well brought out by the figures, especially when the right side of Fig. 1 is compared with the left side of Fig. 1A.

It seems to me possible that this wide difference between the surfaces is an adaptation associated with the normal position assumed by the moth: that in the usual attitude of prolonged rest the under surface is well illuminated while the upper is in comparatively deep shadow. If approached from the well-lighted side all the detail would be apparent; if from the dark side the light would be seen shining through the meshes. The upper surface has developed, on this hypothesis, all that could be seen on the shaded side of a dead leaf undergoing destruction by the attack of a fungus, the under surface all that could be seen on the well-lighted side.

There is however another more probable interpretation which suggests itself,—that the fungus model is a species which attacks the leaf on one surface only, presumably the lower, finally destroying the tissues as far as the upper, cuticle or even so far as to cause complete perforation. And the final stage, that of transparency, would then be seen on

the upper surface, all the earlier stages on the lower. The upper surface of the moth would of course represent the former and its under surface the latter. It is to be hoped that the fungi attacking dead leaves in tropical America will be observed from the points of view here suggested, as well as the precise attitude of rest assumed by the moth.

It is interesting to compare with *Dracenta rusina* the small South American Locustid, *Plagioptera bicordata*, of which the upper surface is shown in Fig. 2, the lower in Fig. 2A of Plate XXXII. Instead of the complex networks of small areas seen on the wings of the moth, the Locustid exhibits on each fore-wing a single coarse network including four large meshes and an isolated area enclosing a brown curved line. The transparent portions are surrounded by a brown margin, sharply demarcating them from the green ground-colour of the tegmina. It is probable that the Locustid in the attitude of prolonged rest, with its tegmina enclosing both body and under-wings, resembles a much bent or even rolled green leaf which has been attacked by a species of fungus producing in living leaves effects in some respects similar to those wrought in the dead leaves to which the moth *Dracenta* bears a likeness.

The two insects come from the same Region, and both are probably widespread. The Locustid is indeed known to be so, while the capture of the moth in Trinidad and Guatemala suggests the likelihood of an extended range.

Explanation of Plate XXXII.

All the figures are the natural size.

Fig. 1.—The Thyridid moth, *Dracenta rusina*, Druce, showing the upper surface. Tunapuna, Trinidad, 1905, L. Guppy. In Coll. W. J. Kaye.

Fig. 1a.—The under surface of the moth shown in Fig. 1. The cryptic resemblance is seen to be more detailed than that of the upper surface, including black fungus-like patches which present an appearance of standing out in relief. It is probable that during rest the lower surface is exposed as much as the upper, and perhaps even more completely.

Fig. 2.—The Locustid, *Plagioptera bicordata*, Serv. Each of the green tegmina is marked by two transparent patches with brown outlines and marked by brown lines. These patches probably resemble the injuries caused by a leaf-attacking fungus. The transparent patches, save for their small number and much larger size, are singularly like those on the totally different insect represented in Fig. 1. Colombia, S. America. In Hope Dep.

Fig. 2a.—The under surface of the Locustid shown in Fig. 2. The appearance resembles that of the upper surface, which in this case is probably the only one exposed during rest.